Interdisciplinary Pain Management

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Introduction

Pain is a complex sensory and emotional experience that impacts multiple areas of a person's life the longer it persists [4]. As pain becomes chronic, longer than 3–6 months, it impacts multiple psychological and social areas with increasing severity [4]. Specifically, it impacts cognitive domains: attention, concentration, executive functioning and word finding [55]. Chronic pain also impacts mood – increasing the chances of depressed mood and anxiety [5]. Lastly chronic pain has tremendous social effects with regard to work, interpersonal functioning and sense of identity [4]. Chronic pain does not only impact an individual, but also impacts society at large with regard to healthcare costs and lost productivity [3].

Given the complex nature of pain as it becomes chronic, the approach that considers biological, psychological and social impacts of pain – the biopsychosocial approach – remains the most useful manner to address these complex set of physical, emotional and cognitive sequelae [4]. Therefore, to treat a complex condition such as chronic pain requires expertise in each of these facets. The interdisciplinary approach to pain management – where multiple disciplines work in a cohesive fashion in one setting – is arguably the best manner in which to address these complex set of factors [26].

Pain is a debilitating condition that impacts over 100 million people in the United States [3]. Furthermore, the cost of pain is estimated to be somewhere between $500 and $635 billion dollars a year when direct medical costs and lost productivity are taken into account [3]. Furthermore, pain is more costly than any other health condition in the United States aside from cardiovascular disease [3]. Although hundreds of billions of dollars is spent on the treatment of pain a year, the prevalence of pain

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continues to rise, especially with regard to the most common type of pain, chronic low back pain (CLBP) [3].

Pain is meant to serve a biologically adaptive function. Specifically, it alerts one to an injury or illness when it is serving its evolutionary purpose [7]. An individual with a broken leg is alerted by pain to take pressure of the leg, or an individual with an infection is notified by pain to treat the injury. However, the longer pain persists, the less adaptive it becomes especially when there is no clear biological benefit for the pain and it simply interferes with an individual's life [4]. It is an axiom that the longer pain persists, the more important the role of psychosocial factors become in the maintenance and aggravation of pain.

Biopsychosocial

The biopsychosocial approach to chronic illness was first described by George Engel – an internist and psychiatrist at the University of Rochester. This approach is meant to supplement, but not replace, the traditional biomedical model of pain [12]. With regard to the biomedical model of pain, pain is assumed to correspond with the degree of tissue damage. From this model, concepts of "functional" vs. "organic" pain developed which suggested that pain has a biological origin in the case of "organic" pain or it is serving some type of psychological/or other "function" with regard to "functional pain." In other words, the biomedical model assumes pain is either "physical" or "psychological" [7]. This perspective is based on the specificity theory of pain developed by Rene Descartes, which presupposes that the amount of tissue damage should equate to the amount of pain a person experiences [7]. This has led to the unfortunate distinctions mentioned above that could also be summarized as "real" versus "fake" pain by those unfamiliar with the complex nature of pain once it becomes chronic.

Although the biomedical model of pain has led to many advancements in the treatment of pain, one could argue that it has struggled to address the growing epidemic of chronic pain. As mentioned, the biopsychosocial model of pain is not meant to exclude the importance of biological factors such as illness and injury in the experience of pain [4]. Rather, it is meant to elaborate the conception of pain to include psychological and contextual factors. As most practitioners who work with individuals with chronic pain understand, the psychological and contextual factors can serve to impair improvement in the experience of pain [7].

Beecher was one of the first researchers to note how the impact of psychosocial factors on the experience of pain [7]. He worked as a surgeon during World War II in Anzio Italy. He noted that 20% of combat soldiers required powerful analgesics despite not being in shock and with serious injuries [10]. It was concluded that the meaning of the pain, which could be associated with no longer being in danger, was not seen as the alarm that others might have experienced it if they were going to be sent back to life-threatening situations [10]. Other studies have found the importance of mood on pain, with better moods being associated with higher pain tolerance than individuals who were experiencing dysphoric or anxious mood states [5].

The role of cognition has also been long understood to play a role in the pain experience. In fact, when individuals are trained in simple distraction techniques their pain tolerance, as measured by the cold pressor tests increase. In addition, self-talk regarding the nature of pain has long been recognized to play a role in the pain experience [5].

Neuroscience of Pain

Our understanding of the neuroscience of pain has grown exponentially over the last 20 years [15]. Although the insight of the Gate Control Theory of pain remains relative today, we have a much clearer understanding of pain pathways and are beginning to understand the way in which the brain changes in response to effective treatment of pain.

Most patients are surprised to learn that they have no pain receptors, but rather nociceptors. These nociceptors – when stimulated at a sufficient intensity and interpreted by the brain as dangerous – often translate to the experience of pain [13]. An essential component of interdisciplinary care is education and helping patients understand that tissue damage does not always equate to pain and that there can be pain without ongoing tissue damage [4, 13]. For instance, in our interdisciplinary pain program we often use the example of cutting oneself in the garden or garage and not even noticing an injury until you see blood. Also, most people are familiar with the concept of phantom limb pain – where a person experiences pain but without nociception.

Understanding the basic neuroscience of pain is an essential element to managing pain and allows individual to gain a better grasp of their symptoms. As mentioned, "Pain is a complex sensory and emotional experience that can vary widely between people and even with an individual depending on the context and meaning of the pain and the psychological state of the person" [5].

The Gate Control Theory of Pain ushered in the psychosocial aspects of our understanding of pain. The theory developed by Melzack and Wall postulated that both peripheral nerve signals and descending signals from the brain could impact an interneuron in the dorsal horn of the spinal column which served a gate-like mechanism [14]. With regard to peripheral nerve signals, rubbing one's leg after bumping it would serve to partially close this gate like mechanism. Descending nerve fibers from the periaquaductal gray area of the brain could also serve to partly mitigate the transmission of signals within someone who was in a pleasant mood or who was distracted, as just two examples [14].

However, with the development of newer technologies, our understanding of the neuroscience of pain has continued to grow [15]. When nociceptive signals pass through the gate-like mechanism of the dorsal horn of the spinal column they first go to the thalamus of the brain – the major relay station of the brain. Projections then connect the signals from the thalamus to the primary and secondary somatosensory cortex that process where a sensation is occurring in the body as well as the texture of the sensation, e.g., an itch or a crunch [15]. However, if someone were

only to experience nociceptive signals in these areas of the brain, they might be at risk of interpreting the signals as more of a crunching than that of a noxious signal [18].

Pain becomes "pain" in the limbic systems of the brain. The limbic system is the pain and emotional processing center of the brain [15]. Although the idea of a limbic "system" is an area of debate within neuroscience, it remains a useful concept regarding the processing of nociceptive signals from the body. Specifically, the limbic system quickly categorizes external and internal input as positive or negative [17]. For instance, a pleasant meal may quickly be categorized by the positive valence system, while a cut to the leg may be processed by the negative valence system.

The limbic system that includes areas of the brain such as the hippocampus, amygdala, basal ganglia, interior cingulate cortex and anterior cingulate cortex [17]. Christopher DeCharms, Sean Mackey and colleagues conducted a series of studies that allowed participants to see activity in their anterior cingulate cortex (ACC) [18]. Through distraction and other commonly practiced pain management techniques subjects were able to decrease activation in the ACC and reduce the pain they experienced [18]. Individuals with chronic pain were able to decrease their pain by 65% and individuals where pain was induced were able to decrease their pain by 25% [18]. Furthermore, Bushnell and colleagues demonstrated in one study the different parts of the brain that were involved in the management of pain [5]. Specifically, in their study they found that attentional modulation was related to the superior parietal lobe, somatosensory cortex and insula. However, emotional control was related to the periaqueductal grey, and prefrontal cortex [5]. Furthermore, these same areas of the brain demonstrate functional changes when an individual engages in cognitive-behavioral therapy. Finally, newer research is demonstrating changes in grey matter in some of the same areas described above when pain improves, but this work remains preliminary [56].

Psychological Impact of Pain

As mentioned, pain is a complex sensory and emotional experience, and the longer pain persists the greater the impact on an individual's life [4]. Anecdotally, individuals with pain may begin to experience difficulty with sleep, difficulty concentrating and lower distress tolerance. As pain persists, it appears to impact more and more areas of an individual's life. As concentration and sleep become impacted, it is not a surprise that performance at work or school may begin to suffer. As difficulty in occupation functioning increases, one's sense of self may begin to diminish.

The most apt analogy to an emotion regarding pain is to that of anxiety. Anxiety serves as a signal that indicates danger in the external or internal world [17]. Pain serves a similar function as it is meant to signal damage to tissue or an illness that requires attention or a change in behavior [13]. However, the consequences of persistent pain are more commonly associated with depression, with estimates as high of 58% of individuals suffering from major depressive disorder [23].

Cognitive consequences of pain appear clear with regard to attention and concentration, but our understanding of the impact of pain is often confounded by co-occurring factors, such factors include difficulty with sleep, medication and mood state [19]. Working memory also appears impaired by pain, especially regarding working memory involving visual systems [19].

Executive functioning refers to the concept of control and reasoning. However, it should be noted that difficulties in one area of cognitive faculties, such as attention and concentration, may inevitably lead to difficulties with executive functioning to some extent. Executive functioning, "refers to our ability to problem solve, learn from errors and organize input as well as our response" [19]. Evidence of the negative impact of pain on cognitive functioning is observed with the Iowa Gambling Task where individuals attempt to win money by engaging in a simulated gambling activity [20]. This test has been shown to correlate with aspects of executive functioning and emotional problems solving [20].

Consistent with the impact of pain on cognitive functioning, various neuroimaging and testing techniques have also begun to note evidence of anatomical changes within the brain [56]. Findings from the neuroscience literature have noted decreases in grey matter in areas central in processing both pain and emotion. Specifically, changes in grey matter have been noted in the anterior cingulate cortex, insula cortex and prefrontal cortex. Some evidence also suggests change in white matter in similar regions [5]. The exact cause and mechanisms of these changes remain unclear, but some researches have hypothesized it is due to neuroexcitation of these circuits over time [5].

As previously mentioned, the emotional impact chronic pain is self-evident to anyone who has had pain for more than 3–6 months. It should be noted that normal reactions of frustration, irritability and worry are not considered psychological conditions. However, as pain continues to tax coping resources and has more detrimental effects an estimated 59% of individuals develop a disorder that meet full criteria for a behavioral health disorder [22]. Previous studies have reported rates of major depressive disorder that range from 34% to 58% [22–24]. When adjustment disorder with depressed mood is also taken into consideration, these numbers rise. Also, in one study an estimated 35% of individuals suffered from an anxiety disorder [24].

Psychological Treatment of Pain

Before proceeding to a more specific explication of how the biopsychosocial approach to pain management is implemented through an interdisciplinary pain management program, a brief review of treatment of pain from a psychological perspective is warranted. The approach taken for many pain practitioners can be summarized as a "top – down" and "bottom – up" approach to pain management. Specifically, "top – down" interventions refer to interventions such as providing education regarding the nature of pain, distinction between the concepts of "hurt" versus "harm" and providing other useful information, including education on general self-care, sleep, appropriate exercise and nutrition [4, 36]. The "top – down"

approaches also include skills training in techniques that have proven to be effective to manage pain, such as mindfulness meditation, relaxation training, pacing, hypnosis, etc. Approaches categorized as "bottom – up" utilize more traditional therapy techniques to assist in addressing maladaptive thoughts, feelings and beliefs regarding pain [4].

Cognitive-behavioral therapy remains the "gold-standard" for the treatment of chronic pain, but increasing evidence supports the use of therapies such as acceptance commitment therapy and emotional awareness and expressive therapy [4, 50, 51]. Cognitive-behavioral therapy posits that the functioning of the clinically relevant aspects of a person can be divided into thoughts, feelings and behaviors [43]. Also these elements of a person are considered to be bi-directional and operate within a system. Therefore, changing one element of the system – thoughts, feelings or behaviors – can change the functioning of the other elements. For example, addressing what are commonly referred to as "automatic negative thoughts" testing them to reasoning and experimentation can lead to more balance, objective and realistic thoughts [43]. Also, finding ways to reinforce adaptive behavior could impact thinking and feeling.

Turk and Gatchel described goals that have been shown to be helpful for individuals suffering from chronic pain [4]. The first goal is to help an individual with chronic pain begin to identify and change thoughts they may be having about their pain from something that feels out of their control to something that could be impacted positively. The next goal is what was previously described as the "top-down" techniques, where individuals learn how to develop self-regulation over some of their physiological functioning through practices such as relaxation training, biofeedback and mindfulness meditation [4].

The remaining three goals involve improving and strengthening coping and resiliency. Specifically, to help individuals move to more active problem-solving approaches and promote a sense of self-efficacy where they feel that there are options to help manage pain. The last two goals involve the ongoing ability to assess the interaction among their thoughts feelings and behaviors. Lastly, the intended outcome is for an individual to be able to apply the armamentarium of tools in multiple settings in flexible and adaptive manners. For instance, finding ways to pace or meditate at work or during other activities of daily living [4].

Interdisciplinary Care

The biopsychosocial approach to approach to pain includes respect of the biological, psychological and social aspects of pain and posits that to effectively treat pain, all three elements, and sub-elements, must be attended to and addressed as much as feasible [26]. Anecdotally, practitioners unfamiliar with practicing in this model may assume that physical pathology is minimized in favor of psychosocial factors. However, that is an inaccurate assumption and physician's typically lead the interdisciplinary programs. Although we now know that there is a weak correlation between the amount of tissue damage/physical pathology with the experience of

chronic pain, there remains a correlation [7]. Medical staff not only lead the interdisciplinary team in most settings but may order additional diagnostic tests and engage different medical specialties. In addition, medication and interventions may also be recommended and implemented withing the context of interdisciplinary care [26].

Along those lines, physical therapy is an essential element of interdisciplinary care. As most reading this will know, is essential to addressing physical contributors to pain through traditional modalities related to graded exercise, stretching and strengthening [39]. Through the years, other techniques have been refined to assist in the decrease of pain and allow for more progressively challenging activity, e.g., dry-needling, craniosacral therapy, etc. However, physical therapy plays a major role in the psychosocial aspect of treatment as well. Specifically, physical therapy is crucial in helping some individuals struggling with kinesiophobia, fear of movement, and avoidance of activity [38]. Also, physical therapy helps promote a sense of self-efficacy mentioned previously [38].

A distinction is often made between multidisciplinary and interdisciplinary, although this distinction is not readily adopted within the pain management field. However, there are important differences. Specifically, interdisciplinary care involves the delivery of care in one setting, allowing staff and faculty to collaborate in both formal (e.g., case conferences) and informal ways. Multidisciplinary refers to the delivery of services from multiple disciplines, but at disparate locations, making collaboration somewhat more challenging [26].

The evidence for the effectiveness of interdisciplinary pain management has accumulated over decades. Functional restoration is a type of interdisciplinary care that was developed for individuals receiving Worker's Compensation benefits who had failed multiple other treatments. In a landmark study, Mayer, Gatchel et al. compared individuals who had undergone a functional restoration program over the course of 2 years [48]. They found that 87% of individuals who had undergone functional restoration were working at 2-years compared to 41% of the comparison group who received treatment as usual. In addition, the investigators found twice as many surgeries in the comparison group than the functional restoration group. Furthermore, the comparison group engaged in five times more health care visits and were more likely to be reinjured [48]. These findings were replicated both in the US and abroad over three decades [26].

Friederich and colleagues evaluated 93 individuals with chronic low back pain and compared standard exercise to interdisciplinary care [57]. They found that even after 5 years individuals who engaged in interdisciplinary care reported lower pain and disability than individuals who engaged in standard exercise [57].

Fairbank and colleagues engaged in a multicenter randomized control trial for 349 individuals with chronic low back pain and compared spinal fusion to interdisciplinary pain management [58]. Both groups showed improvement with regard to pain ratings and disability on self-report measures. However, the cost of interdisciplinary care was almost half of the cost of spinal fusion [58].

Other efforts examining interdisciplinary care have focused on the intensity of treatment. Skouen and colleagues examined 195 clients with chronic low back pain

and compared a "light" interdisciplinary program, to a more intensive interdisciplinary program to treatment as usual [59]. The investigators found that interdisciplinary care had better outcomes than treatment as usual. Furthermore, they found that there was not differences between light or intensive interdisciplinary pain programs [59].

The long-term effectiveness of interdisciplinary care was also reinforced by the work of Oslund and colleagues through an intensive interdisciplinary pain program that combined physical therapy, cognitive-behavioral therapy, occupational therapy and intensive case management [60]. As one would expect, there were significant improvements in both pain reduction and hours resting after the four-week program. However, these gains were also maintained after 1 year [60].

The cost effectiveness of interdisciplinary care has also been evaluated. For instance, Gatchel and Okifuji found that annual medical costs were reduced by 68% in individuals who engaged in interdisciplinary care [61]. Furthermore, when the costs saving were extrapolated to evaluate the difference between individuals who underwent conventional care compared to interdisciplinary care, the results reflected a significant cost savings [61].

Conclusion

Chronic pain is a costly and debilitating medical condition that impacts multiple areas of an individuals life. The biopsychosocial approach to pain management builds upon the traditional biomedical model and it expands the area of focus to also include psychological and social functioning. The evidence for the effectiveness of interdisciplinary care to address the underlying biological, psychological and social factors have accumulated over decades to demonstrate the effectiveness of this approach.

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